DEPARTMENT OF
ELECTRICAL &
COMPUTER ENGINEERING

Application of LabView to Control the Feedback Loop in a Photothermal Interferometer

J.C.Alvarado / C.C. Davis, J. Gillespie, P. Pellegrino, N. Fell

Introduction

The photothermal interferometer is being investigated for possible use as a chemical detection sensor in chemical warfare. The purpose of this project was to develop a feedback loop which controls a piezoelectric transducer. This software interface was developed to both control the piezoelectric transducer and to reduce mechanical interaction with the interferometer. The interface also automates the feedback process to reach quadrature in a more systematic fashion and reduces downtime.

Background

A HeNe Laser used in conjunction with an IR Beam to analyze a gaseous sample of a chemical at some minute concentration. Using a Jamin plate interferometer configuration, the laser beam is split in half through a beam splitter, producing two beams of equal intensity and frequency. If the beams are not balanced prior to the introduction of IR beams, results could be skewed due to thermal drift. The reason there is such a high concern about "balancing" the beams is that at this critical point the interferometer is at its most sensitive position.

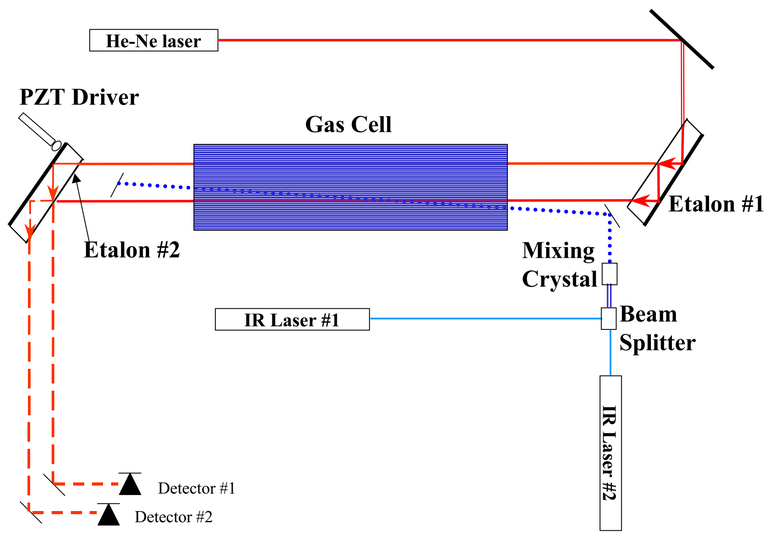
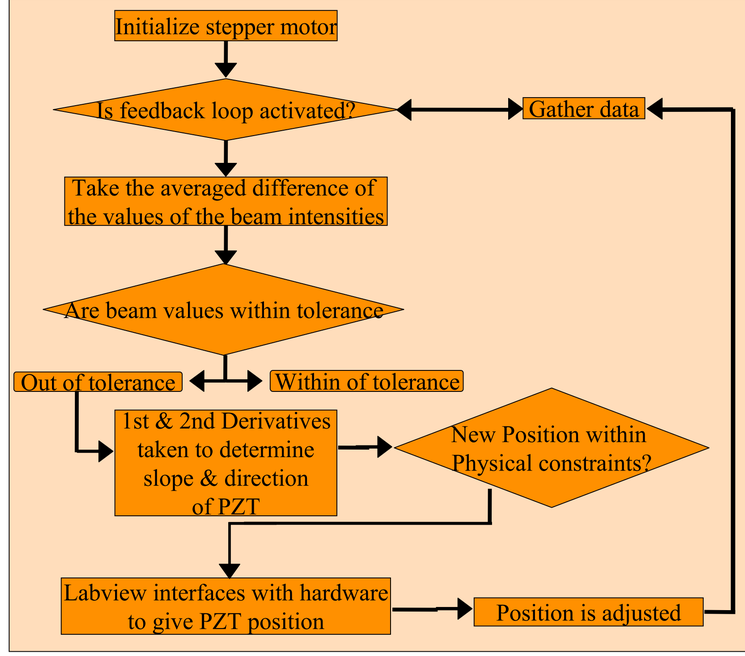


Figure 1. Jamin Plate Interferometer schematic

Methodology

- Use LabView (Fig 2.) to control position of piezoelectric drive for balancing interferometer
- Determine direction & size of steps via examination of 1st and 2nd derivatives of position vs. signal difference curve
- Only activate feedback loop when IR beam excitation is off

Block Diagram of Interferometer Feedback Loop



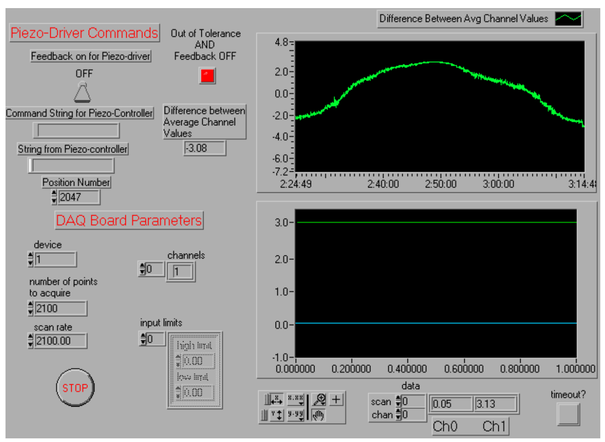
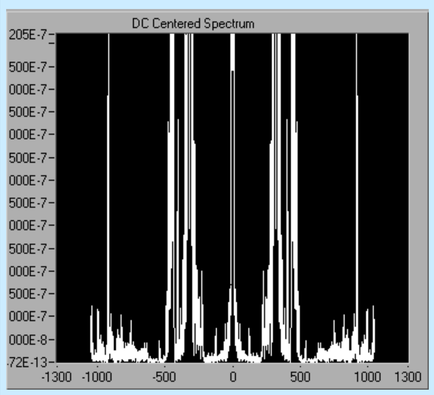


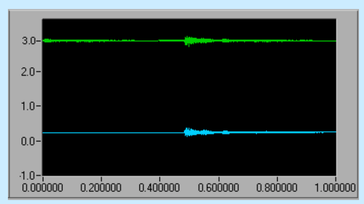
Figure 2. LabView front panel

Experimental Setup

- Beam is fired from the HeNe laser
- Beam is split by etalon plate
- IR laser is turned on and chopped at ½ duty cycle
- Beams are recombined, with the phase change, in etalon #2
- Beams are then reflected to photodetectors, and processed by LabView

Results





These are the results, showing the sensitivity of the interferometer. These are readings taken by LabView, of the signal picked up by the interferometer, of a 5/16" washer, dropped 4 ½ ft. away from the interferometer.

Future Directions

- Check how feedback loop works with cuvet introduced in the interferometer
- Use lockin amplifier to amplify the signal we are attempting to detect
- Use noise damping material to minimize ambient noise, and vibrations from the optical breadboard